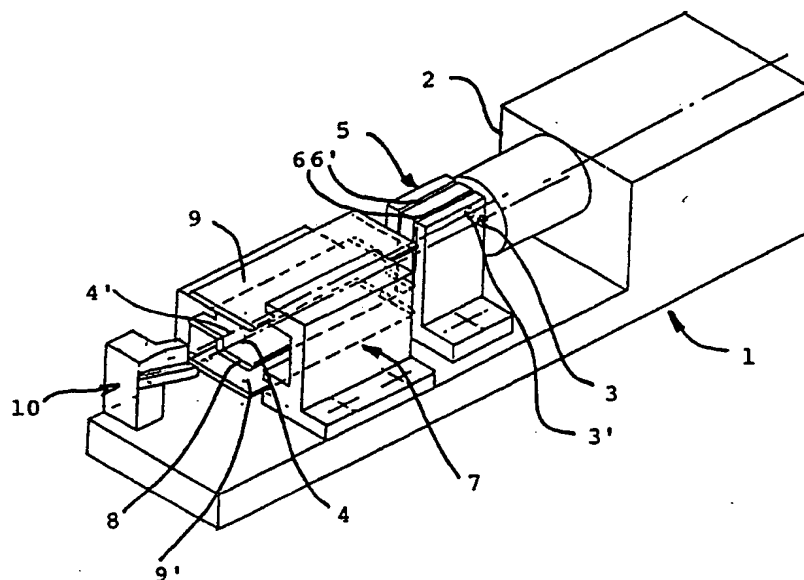


PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : B41J 2/025, 2/09	A1	(11) International Publication Number: WO 91/11327 (43) International Publication Date: 8 August 1991 (08.08.91)
(21) International Application Number: PCT/GB90/02040 (22) International Filing Date: 21 December 1990 (21.12.90) (30) Priority data: 9001654.4 24 January 1990 (24.01.90) GB (71) Applicant (for all designated States except US): DOMINO PRINTING SCIENCES PLC [GB/GB]; Bar Hill, Cambridge CB3 8TU (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): LECHEHEB, Ammar [GB/GB]; 57 Barry Lynham Drive, Newmarket, Suffolk CB8 8YU (GB). MITCHELL, Richard, Frank [GB/GB]; 13 Coppice Avenue, Gt. Shelford, Cambridge CB2 5AQ (GB).		(74) Agent: BRUNNER, Michael, John; Gill Jennings & Every, 53/64 Chancery Lane, London WC2A 1HN (GB). (81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i>

(54) Title: PRINthead FOR CONTINUOUS INK JET PRINTER**(57) Abstract**

A printhead (1) for a continuous ink jet printer has a single pair of nozzles (3, 3'). One or more oscillators for vibrating the ink (3, 3') may be used to break up the twin streams (4, 4') of droplets issuing from the nozzles. A pair (5) of charging gates is provided for applying, selectively and respectively, a charge to droplets in the two streams (4, 4'). A pair of deflector means (7) apply respective electric fields across the streams (4, 4') to deflect the droplets individually in accordance with the charge thereon. A gutter (10) or pair of gutters (11, 11') receive droplets from the respective streams if they are not charged. The arrangement is such that the two streams of droplets are deflected in opposite directions so as to be printed.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark				

PRINthead FOR CONTINUOUS INK JET PRINTER

The present invention relates to ink jet printers and, more particularly, to the printhead of a so-called
5 continuous ink jet printer.

Printers of this type have a printhead with one or more nozzles connected to a supply of ink, a string of droplets being caused to flow from the nozzle or nozzles by means of an oscillator, usually a piezoelectric transducer.
10 The row of droplets is directed towards a gutter, but selective droplets can be charged as they leave the nozzle and then deflected in an electric field in order to impinge on a substrate, individual droplets being charged appropriately in order to print at the correct position.

15 In order to print multiple lines of print from a single nozzle, it is known to provide an array of nozzles and associated piezoelectric transducers arranged closely adjacent to one another, but a problem with this type of printer is that the height of the lines of print is limited
20 by the pitch of the nozzles. Such printers also require the nozzles to be carefully matched in terms of size and directional uniformity as well as positioning relative to one another.

It is known to print multiple lines of print from a
25 single nozzle (see for example our EP-B-0206614), but although this technique is capable of providing multiple lines of print at high speed, the number of lines that can be printed is relatively small.

There is a need therefore for a printer capable of
30 printing several lines of print without the complexity of an array of nozzles.

According to the invention therefore, there is provided a printhead for a continuous ink jet printer, comprising a single pair of nozzles; one or more
35 oscillators for vibrating the ink to provide twin streams of droplets from the nozzles in use; a pair of charging gates for applying, selectively and respectively, a charge

to droplets in the two streams; a pair of deflector means for applying respective electric fields across the streams to deflect the droplets individually in accordance with the charge thereon; and, a gutter or pair of gutters into which
5 droplets from the respective streams may pass if they are not charged, the arrangement being such that the two streams of droplets are deflected in opposite directions so as to be printed.

By providing only two nozzles and by deflecting the
10 two streams in opposite directions, the height of the two lines of print is not restricted by the pitch of the nozzles.

Furthermore, the printhead may be arranged so that the nozzles are substantially aligned in the direction in which
15 the substrate to be printed moves relative to the printhead, whereby continuous columns of droplets can be printed over the full printing width of the printhead so as to allow printing of large characters, bar codes, etc., as well as multiple lines of characters. The known offset
20 between the nozzles can be taken into account by suitable control electronics in order to allow the printed droplets from each nozzle to be aligned to produce single, full height columns of printed dots.

In such an arrangement the charging gates preferably
25 comprise a single assembly providing two charging paths for the respective droplet streams and the deflector means comprises three deflector plates, the central one of which is at a first voltage and the outer ones of which are at a second voltage. The central deflector plate is also
30 preferably of a lazy-Z shape, whereby the two streams of droplets pass on opposite sides of the centre web of the 'Z' in order to be able to be aligned in the direction of movement of the substrate. The gutter assembly may also have a lazy-Z shape when viewed in cross section, one
35 gutter inlet being provided in each flange of the 'Z'.

The nozzles may have respective oscillators, or may be vibrated by a single oscillator, such as a piezoelectric transducer.

5 A printhead of the invention can be used to print for example up to eight lines of characters, can print across a wider web than with conventional single nozzle printers and can also print two lines of information at the same speed and quality that a single nozzle printhead can print one line.

10 Furthermore, character height is not limited by nozzle pitch and there is no requirement for position detectors to achieve a full graphics capability, as there is with array type printers. The simplicity of the printhead allows corresponding simplicity in the control and drive
15 electronics, resulting in lower cost.

The electronic control of droplet charging and deflection may be conventional, is well known in the art and will not be further described.

20 One example of a printhead constructed in accordance with the present invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is an isometric, diagrammatic representation of the printhead;

25 Figure 2 is a diagrammatic representation of the streams leaving the nozzles; and,

Figure 3 is a diagrammatic representation of the printing process.

30 The printhead 1 has a gun body 2 with a pair of nozzles 3,3' of conventional type. As shown in figures 1 and 2, from each of the nozzles is directed, in use, a stream 4,4' of droplets. Each stream 4,4' passes through a phase detector and charging assembly 5, which has different apertures 6,6' for each of the streams and whereby individual droplets in each of the streams can be
35 individually and differently charged.

After passing through the charging assembly 5, the two streams 4,4' pass through a deflector plate assembly 7 in

the form of three plates 8,9,9', across which an electric field is established in order to deflect the charged droplets. As the two streams are to be deflected in opposite directions, the central plate 8, which, as can be seen, is of a lazy-Z shaped cross-section, is held at a first voltage (which may be ground) and each of the outer plates 9,9' is held at the same different voltage, so that deflection of two similarly charged droplets in the two streams is substantially the same but in opposite directions. Droplets that are not to be printed are passed to a gutter assembly 10 which also has a substantially lazy-Z shaped cross section as most clearly seen from figure 3, which is a diagrammatic view of the gutter looking down the streams 4,4', though the streams 4,4' themselves are shown partly from above for clarity. A pair of gutter inlets 11,11' are formed, one in each limb or flange of the 'Z'.

Although the droplets which are not to be printed may be substantially uncharged and therefore undeflected, preferably and as shown, droplets which are not to be printed are deflected 12 into the respective gutter 11 by having a charge of opposite polarity to that normally applied to the printed droplets applied to them in the charging assembly. This enables the nozzles to be substantially aligned in the direction of movement of the substrate (arrow A), preferably very slightly offset by the normal distance between printed droplets on the substrate, so that continuous characters can be printed using droplets from both streams and thus extending in height over the whole printing width of the printhead. The undeflected droplets from the two streams are thus adjacent one another in a full height character as can be seen from the streams and representative characters shown in figure 2. This may be particularly useful for printing large barcode symbols.

Whilst the gutter assembly 10 and central deflector plate 8 each have a lazy-Z shape in the example described,

other configurations, for example, single parallel plates (i.e. without an intermediate connection) may be used.

CLAIMS

1. A printhead (1) for a continuous ink jet printer, comprising a single pair of nozzles (3,3'); one or more
5 oscillators for vibrating the ink (3,3') to provide twin streams (4,4') of droplets from the nozzles in use; a pair (5) of charging gates for applying, selectively and respectively, a charge to droplets in the two streams (4,4'); a pair of deflector means (7,8,9,9') for applying
10 respective electric fields across the streams (4,4') to deflect the droplets individually in accordance with the charge thereon; and, a gutter (10) or pair of gutters (11,11') into which droplets from the respective streams may pass if they are not charged, the arrangement being
15 such that the two streams of droplets are deflected in opposite directions so as to be printed.

2. A printhead according to claim 1, wherein the charging gates comprise a single assembly (5) providing two charging
20 paths for the respective droplet streams (4,4').

3. A printhead according to claim 2, wherein the deflecting means comprises three deflector plates (8,9,9'), the central one (8) of which is at a first voltage and the
25 outer ones (9,9') of which are at a second voltage.

4. A printhead according to claim 3, wherein the central deflector plate (8) is of lazy-Z shape, the two streams of droplets passing in use on opposite sides of the central
30 web of the 'Z' in order to be able to be aligned in the direction of movement of the substrate.

5. A printhead according to claim 4, wherein the gutter (10) has a lazy-Z shape, one gutter inlet (11,11') being
35 provided in each flange of the 'Z'.

1/2

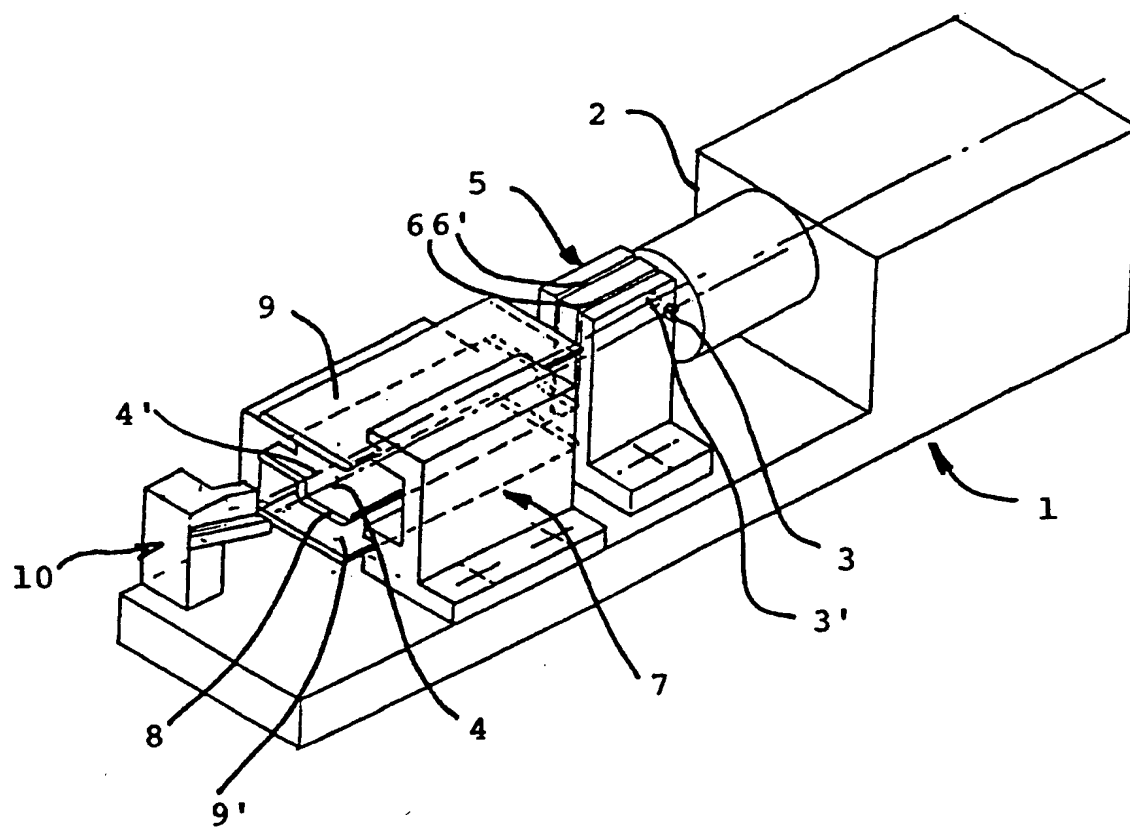


FIG. 1

SUBSTITUTE SHEET

2/2

FIG. 2

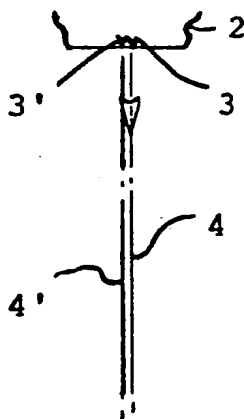
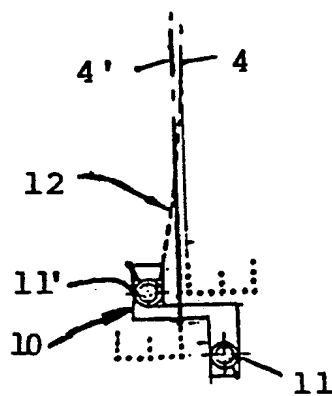


FIG. 3



↓ A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 90/02040

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 B41J2/025 ; B41J2/09		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B41J	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ^o	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4194210 (K.A. KRAUSE) 18 March 1980 see column 5, line 43 - column 6, line 45 see figures 6-9. ---	1-3.
A	EP,A,84891 (TMC COMP.) 03 August 1983 see page 5, lines 1 - 18 see page 8, line 13 - page 9, line 34 see page 17, line 12 - page 18, line 2 see figures 1-4. ---	1.
A	PATENT ABSTRACTS OF JAPAN vol. 4, no. 171 (M-44)(653) 26 November 1980, & JP-A-55 123480 (Y. EBI) 22 September 1980, see the whole document ---	4.
A	WO,A,8800529 (IMAJE SA.) 28 January 1988 ---	
A	US,A,4604547 (T. SAITO) 05 August 1986 ---	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> ^o Special categories of cited documents : ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </div> <div style="width: 45%;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search <div style="text-align: center;">25 MARCH 1991</div>	Date of Mailing of this International Search Report <div style="text-align: center;">19 APR 1991</div>	
International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center;">VAN DEN MEERSCHAUT G </div>	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

PCT/GB 90/02040
SA 43137

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25/03/91

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4194210	18-03-80	CA-A- 1068328	18-12-79
		DE-A, B, C 2713512	13-10-77
		FR-A, B 2346154	28-10-77
		GB-A- 1568551	29-05-80
		JP-C- 1168101	30-09-83
		JP-A- 52119325	06-10-77
		JP-B- 57058301	09-12-82

EP-A-84891	03-08-83	CA-A- 1202522	01-04-86
		JP-A- 58132566	06-08-83
		US-A- 4596990	24-06-86

WO-A-8800529	28-01-88	FR-A- 2601625	22-01-88
		AU-A- 7707387	10-02-88
		EP-A- 0262004	30-03-88
		EP-A- 0274507	20-07-88
		JP-T- 1500341	09-02-89
		US-A- 4905018	27-02-90

US-A-4604547	05-08-86	JP-A- 59148248	24-08-84
		AU-B- 571195	14-04-88
		AU-A- 2440584	23-08-84
		CA-A- 1202358	25-03-86
		DE-A- 3405230	16-08-84
		FR-A, B 2541041	17-08-84
		GB-A, B 2135817	05-09-84
		NL-A- 8400475	03-09-84
